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Original Article

Mandibular Buccal Bone Thickness In Southeastern Anatolian People: A Cone-Beam Computed Tomography Study

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Abstract

Aim: Buccal bone thickness is an important factor in implant treatment, bone health after tooth extraction, apical surgery, and esthetic outcomes. We evaluated the distance from the mandibular premolar and molar teeth apices to the buccal cortical bone in southeastern Anatolian people using cone-beam computed tomography (CBCT).
Methodology: This retrospective study was performed in 461 posterior teeth (220 premolars, 241 molars) of 133 patients (62 females, 64 males) at Dicle University, Faculty of Dentistry, Department of Oral and Maxillofacial Radiology. Data were analyzed using Student's t-tests and Tukey HSD tests.
Results: The mandibular buccal bone was thicker in men than in women, but the difference was not statistically significant ($p>0.05$). The thinnest point of the mandibular buccal bone was measured in women as 2.431 mm and in men as 2.491 mm in the first premolar teeth. The thickest point of the mandibular bone was measured in women as 7.940 mm and in men as 7.859 mm in the distal roots of mandibular second molar teeth. For the mandibular first and second premolars, there was no significant difference in buccal bone thickness among the 10–29-, 30–49-, and 50–69-year age groups. The difference between the first and second molar mesial and distal roots of the age groups was significant at the level of buccal root thickness ($p<0.05$).
Conclusions: It is important to examine buccal bone thickness (with CBCT) before surgical dental procedures for appropriate implant planning and surgical endodontic treatment.

Keywords: Buccal bone thickness, cone-beam computed tomography, mandible, alveolar bone

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Introduction

Manipulation of surgical instruments and securing the surgical field are limited in many ways during apical surgery. One factor involved is buccal bone thickness. Large buccal cortical bone loss also negatively affects the recovery period after surgery. Several studies have measured buccal thickness in the maxilla anterior region (1-6).

Buccal bone thickness in the posterior region is an important anatomical feature in routine dental treatment, especially in endodontic surgery, dental implant procedures, and healing after tooth extraction (7). The length and diameter of the implants to be used vary according to the corresponding field in terms of buccal bone thickness (8). Endodontic apical complications during surgery can be reduced by knowing the thickness, and a more successful surgical operation can be performed. The degree of root resorption in orthodontic treatment, tooth movements that may occur during treatment, and the time of treatment may vary according to the thickness of the buccal bone. In orthodontic treatments, the mini-implants used also vary according to the thickness of the buccal bone (9-11).

Imaging in the maxillofacial region used cone-beam computed tomography (CBCT) in 1997 for the first time. With high-resolution scanning, this technique allowed three-dimensional oral and maxillofacial regions to be displayed (12). CBCT devices are easier to use and less expensive than conventional computed tomography (CT) equipment. The shorter scan time due to advanced image sensors also allows quicker scans, reducing the radiation dose (13). Because anatomical structures may occur in superposition in panoramic images, and horizontal and vertical magnification (10–33%) may be insufficient in buccolingual sections, the use of CBCT has become widespread (8, 14, 15). Indeed, the use of CBCT in the field of dentistry is now very broad. CBCT is used in the preoperative planning of dental implant surgery and before endodontic surgical procedures; in the assessment of internal/external root resorption, root perforations during dental treatment, differences in dental anatomy, root canal anatomy, benign/malignant cysts or tumors, and periapical lesions; and in the diagnosis of dental trauma (16, 17).

The aim of this study was to evaluate the distance from the mandibular premolar and molar teeth apices to the buccal cortical bone in the southeastern Anatolian people, using CBCT images.

Materials and Methods

This retrospective study was performed in 461 premolar and molar teeth of 133 patients who were referred between January and December 2015 to Dicle University, Faculty of Dentistry, Department of Oral and Maxillofacial Radiology. All images were obtained with an I-CAT Vision (Imaging Sciences International, Hatfield, PA, USA, 2008). The scanning parameters were 120 kVp, 5 mA, 8-9 s, 0.3-mm voxel size, and a 13 × 10-cm image area. Patients occupied a fixed position in the device relative to the vertical line parallel to the sagittal plane and to the horizontal line passing through the Frankfurt plane, parallel to the ground. This was a retrospective analysis of CBCT images, so the 'as low as reasonably achievable' (ALARA) principle was followed. Patients with extracted mandibular teeth, dental surgery, radiological evidence of a cyst, traumatic bone fractures, periodontal disease, or benign/malign tumors and edentulous cases were excluded. All patients had full dentition. Scans that had excessive scatter due to the presence of existing restorations or implants were also excluded.

Among the 200 CBCT scans, 461 premolar and molar teeth (220 premolars, 241 molars) in 133 patients (62 females, 64 males) met the inclusion criteria. Patients were grouped into three age categories (10–29, 30–49, and 50–69 years) and were divided by sex. Sex and age were recorded for each patient. To identify the apex on the 0.3-mm cross-sectional axial CT images, the last root apex visible in the image was considered an apex. If the mandibular molar had two mesial canals, the midpoint of two canals was deemed the apex. The shortest horizontal distances from root apices of the mandibular premolars and molars to the outer surface of the buccal bone were determined from axial images (Figure 1, 2, 3).

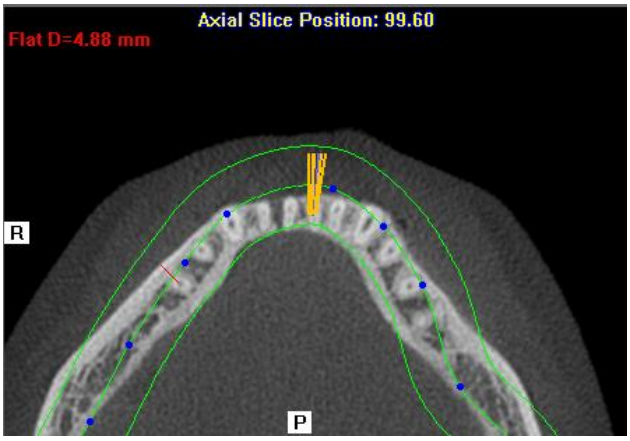

Figure 1. Distance between the first premolar apex and the buccal bone plate.

Statistical Analysis

For comparisons of the groups by sex, the Kolmogorov–Smirnov test showed a normal distribution, so an independent-group Student's t-test was used. The level of significance was set at p>0.05.
For comparisons of age groups, the Kolmogorov–Smirnov test showed a normal distribution, so one-way ANOVA was used. P-values <0.05 were considered to indicate statistical significance. Comparisons of the groups among themselves were made using Tukey's HSD test. All statistical analyses were performed using the SSPS software (version 20.0).

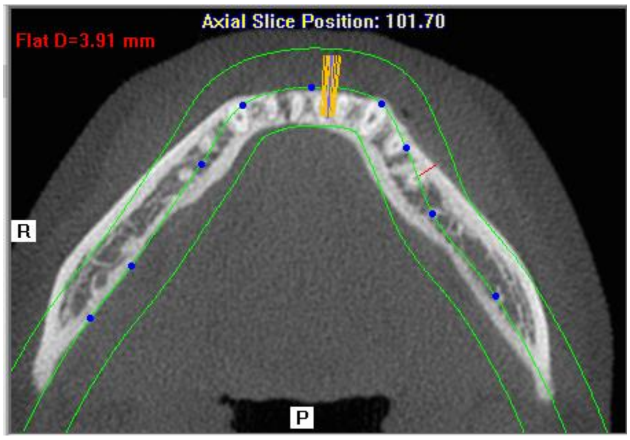

Figure 2. Distance between the second premolar apex and the buccal bone plate.

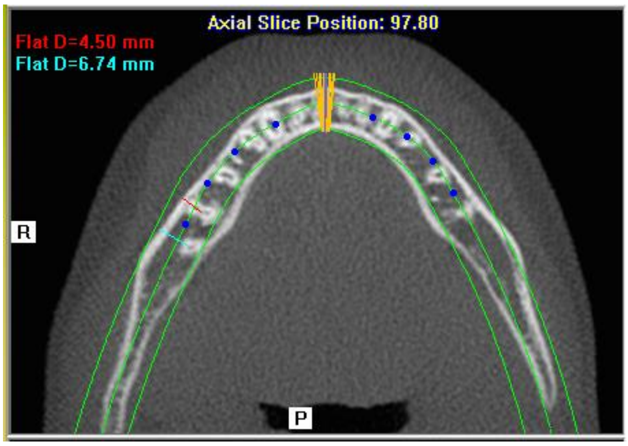

Figure 3. Distance between first molar mesial and distal apex and the buccal bone plate.

Results

In our study, measurements were made from 461 premolar and molar teeth of 133 patients. Patients were grouped into three different age groups (10–29, 30–49, and 50–69 years) and further divided by sex.

The thinnest point of the mandibular buccal bone was measured in women as 2.431 mm and in men as 2.491 mm at the first premolar teeth. The thickest point of the mandibular bone was measured in women as 7.940 mm and in men as 7.859 mm at the distal roots of mandibular second molar teeth (Tables 1 and Figure 3).

Table 1. Descriptive statistics for mandibular buccal bone thickness by sex (mm)

	1st Premolar	2nd Premolar	1st Molar		2nd Molar	
			Mesial	Distal	Mesial	Distal
Female	2.431 ± 0.732 (*n* = 56)	2.753 ± 0.929 (*n* = 54)	4.597 ± 0.958 (*n* = 49)	5.038 ± 1.421 (*n* = 49)	6.817 ± 1.940 (*n* = 59)	7.94 ± 1.691 (*n* = 59)
Male	2.491 ± 0.655 (*n* = 55)	2.804 ± 0.926 (*n* = 55)	4.568 ± 0.937 (*n* = 52)	4.777 ± 1.361 (*n* = 52)	7.051 ± 1.870 (*n* = 59)	7.859 ± 2.019 (*n* = 59)

* All data are expressed as means (mm) ± SD. 'n' indicates the number of obtainable measurements from the samples in each age group p > 0.05

The buccal thickness of at least the first premolar was also measured in all teeth groups. Although the buccal bone was thinner in women than in men, the difference was not statistically significant (p>0.05).

A comparison of buccal bone thickness at the first and second premolars among age groups found no statistically significant difference (p>0.05). In the mesial and distal roots of first molars, significant differences were found between the 10–29- and 30–49-year age groups. In individuals aged 10–29 years, the buccal thickness of the mesial root was 4.805 mm, whereas in the 30–49-year age group, it was 4.292 mm. Regarding the distal bone thickness, the mean values in the 10–29- and 30–49-year age groups were 5.247 mm and 4.508 mm, respectively.

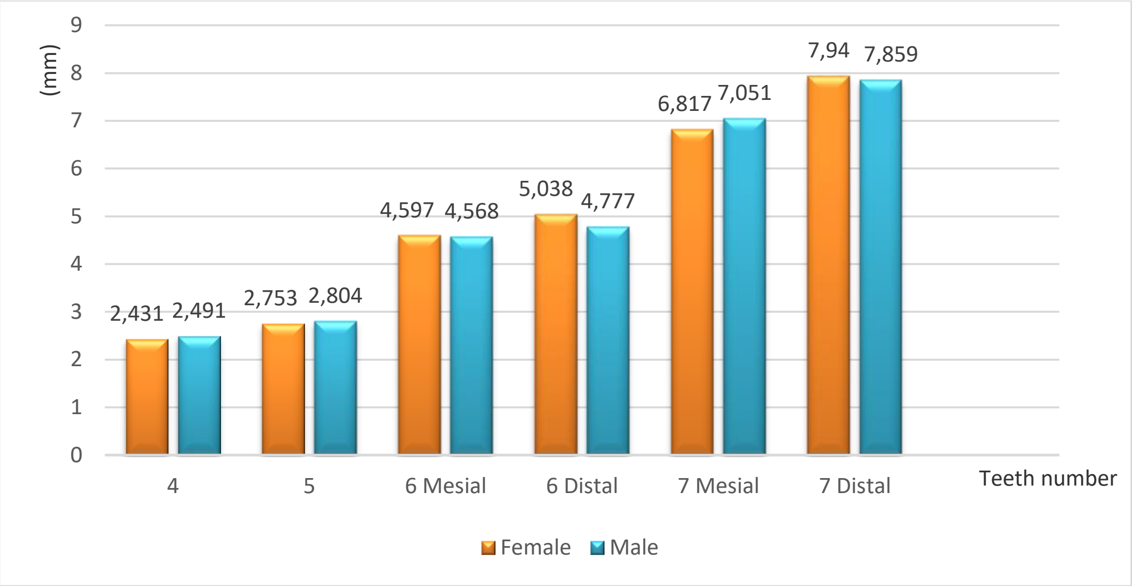

Figure 4. Descriptive statistics for mandibular buccal bone thickness by sex (mm)

At the mesial root of the mandibular second molar, significant differences were found between the 10–29-year and the other age groups (p<0.05). In individuals aged 10–29, the buccal thickness was 7.663 mm, in the 30–49-year group, it was 6.332 mm, and in the 50–69-year group, it was 5.197 mm. At the distal root of the mandibular second molars, a significant difference was found among the age groups (p<0.05). The mean values for the 10–29-, 30–49-, and 50–69-year age groups were 8.492, 7.666, and 5.134 mm, respectively (Tables 2, 3 and Figure 4, 5).

Table 2. Descriptive statistics for mandibular buccal bone thickness in different sites and age groups (mm)

	1st Premolar	2nd Premolar	1st Molar		2nd Molar	
Age Groups (years)			**Mesial**	**Distal**	**Mesial**	**Distal**
10–29	2.499 ± 0.704	2.764 ± 0.902	4.805 ± 0.997	5.247 ± 1.357	7.663 ± 1.852	8.492 ± 1.538
30–49	2.422 ± 0.702	2.816 ± 1.027	4.292 ± 0.781	4.508 ± 1.269	6.332 ± 1.613	7.666 ± 1.685
50–69	2.371 ± 0.575	2.708 ± 0.567	4.172 ± 0.840	3.785 ± 1.730	5.197 ± 1.484	5.134 ± 2,069

* All data are expressed as means (mm) ± SD. $p < 0.05$

Table 3. Descriptive statistics for mandibular buccal bone thickness in different age groups

	4	5	6		7	
Age groups (years)			Mesial	Distal	Mesial	Distal
10–29/30–49	X	X	0.022*	0.024*	0.000*	0.028*
10–29/50–69	X	X	X	X	0.000*	0.000*
30–49/10–29	X	X	0.022*	0.024*	0.000*	0.028*
30–49/50–69	X	X	X	X	X	0.000*
50–69/10–29	X	X	X	X	0.000*	0.000*
50–69/30–49	**X**	**X**	**X**	**X**	**X**	**0.000***

* : The mean difference is significant at the 0.05 level. P<0,05
X :no statistical significance

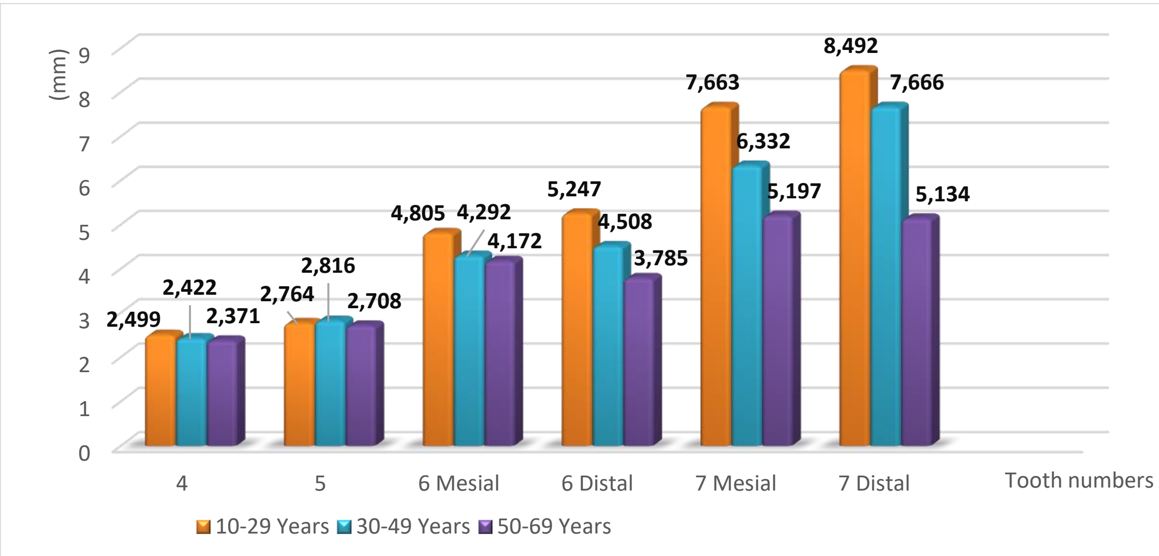

Figure 5. Mandibular buccal bone thickness in different age groups (mm)

Discussion

Both human and animal studies have shown that after tooth extraction, the alveolar crest is restructured, and the anatomy of the buccal bone during the healing process after a dental implant is an important issue (18, 19). Miyamoto et al., in a study about the primary stabilization of implants and implant selection, demonstrated the importance of buccal bone thickness (20).

Conventional radiography and periapical and panoramic radiographs are the initial preoperative radiographs used to assess apical surgery in the mandible (21). However, a lack of knowledge about the buccolingual thickness of the jaw bone due to image magnification and distortion can hinder surgery or cause complications (22, 23). More accurate measurements are possible with CBCT and its three-dimensional images than with conventional (21, 24) or panoramic radiography (25, 26).

Franke et al., in a study conducted on 33 cadavers, measured mandibular buccal bone thickness at the mesial root of the first and second molars as 4.18 mm and 7.35 mm, respectively (27). In Jin et al., these values were reported from 66 patients as 4.09 mm and 7.34 mm (28). In our study, we measured thicknesses at the first and second molar mesial roots as 4.58 mm and 6.93 mm, respectively.

In our study population, although the buccal bone was thinner in women than in men, the difference was not statistically significant. These results were consistent with those of Zhao et al., Deguchi et al., and Lim et al., although Ono et al. reported that the bone was thicker in women than in men. The reason for the differences may be the number of patients examined (29-32).

Sathapana et al. examined age-related changes in mandibular buccal bone thickness in 82 CT images and reported no statistically significant difference according to age group (33). In contrast, Swasty et al. observed a significant difference in bone thickness between the 10–19-year-old group and those aged 20 years and older. In addition, the buccal bone has been reported to approach maximum thickness in the 20–29-year age group, and to decline after 40–49 years (34). In our study, as in Swasty et al., significant differences between age groups were found in mandibular premolar–molar buccal bone thickness. In the 10–29-year age group, buccal thickness at the first molar mesial and distal root was significantly greater than that of the 30–49-year age group. In addition, buccal thickness at the second molar mesial and distal root was significantly greater in the 10–29-year age group than in the other age groups. Temple et al. reported that in female patients, the buccal bone thickness in the 60–69-year age group was significantly thicker than that in men of the same age at the second molar distal root. These results were consistent with our work (35).

With an increase in bone resorption with age, body catabolism may lead to a reduction in the thickness of the buccal bone. Another source of bone destruction is long-term functional stress; the thickness of the cortical bone in edentulous maxilla and mandible is less than that in dentulous jaws, which may result in a reduction in buccal bone thickness (36). Another factor affecting buccal bone thickness is the nature of the face. Masumoto et al. reported that short-faced people had thicker cortical bones than did average- or long-faced people (37).

Conclusions

With conventional radiography and panoramic radiographs, we simply cannot make buccolingual measurements that are possible with CBCT. With CBCT, buccal bone thickness can be measured in healing scenarios after surgery and dental procedures, which is important for dentists. Moreover, before dental procedures, we know that there are differences in buccal bone thickness by sex and age group. Determining these differences enables clinicians to take necessary measures and helps to reduce the risk of complications.

Acknowledgments

The authors deny any conflicts of interest related to this study.

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